Space Weather Forecast

Issued on Saturday, 16 December 2023 at 00:39 Local

This forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate-flares likely, and chance of Strong flares (R1-R3). G1-G2/Minor-Moderate Storms possible Days 1 and 2 (16-17 Dec) with CME arrivals, slight chance of G3/Strong Storms. S1/Minor Radiation Storm in progress, risk reducing later in the period.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Moderate with a double peak flare from a complex region in the northwest disc, peaking at 15/0734 UTC. This was the region also responsible for a Strong flare on the 14 Dec. This region does look as though it is decaying slightly, probably starting to lose some magnetic complexity, although it is becoming difficult to tell as it continues to rotate towards the western limb. In total there are ten sunspot regions on the disc, of which a region in the southeast has grown recently, but is not significantly magnetically complex. The other regions remain much smaller and simpler, although a couple of new regions are appearing near the east limb and may be more complex than can currently be seen.
Two Coronal Mass Ejections (CMEs) were observed in the last 24 hours with a potential Earth-directed component. One from the double-peak flare at 15/0734 UTC, but this is now considered most likely to miss ahead of Earth. We are awaiting imagery after a recent eruption near south centre disc to see if this has produced a CME.

Solar Wind / Geomagnetic Activity: Solar winds showed a weak CME arrival at 15/1057 UTC. Wind speeds were initially at background levels, around 300 km/s, but jumped after the CME arrived and varied between 370-500 km/s. The interplanetary magnetic field was weak, becoming moderate to strong after the CME arrived. The north-south component was weakly negative (southward), then varied mostly moderately after the CME arrival. Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The count rate of energetic particles (high energy protons) gradually rose just above the S1/Minor Radiation Storm Level during the period.

Four-Day Space Weather Forecast Summary
Solar Activity: Moderate to High activity expected with the ongoing likelihood of Moderate class (R1-R2) flares and a chance of further isolated Strong class (R3) flares from the complex sunspot region in the northwest. This risk recedes later Day 2 and through Day 3 (17-18 Dec) as the region rotates off the disc.

Solar Wind / Geomagnetic Activity: There are a number of possible Earth-directed CMEs. The first is expected to arrive early Day 1 (16 Dec), but any impact is likely to be limited due to the faint nature of the CME. The Strong flare on 14 Dec produced a moderately fast CME which is likely to have an Earth-directed component, most probably arriving early on Day 2 (17 Dec). However confidence in this analysis is rather low. A further weak CME early on 14 Dec looks to be cannibalised by the Strong flare CME. It is possible that there is some weak coronal hole fast wind influence at present, but largely masked by the current CME arrival. A further coronal hole may then enhance the solar wind speed to elevated levels on Day 3 or more likely Day 4 (18-19

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Dec).
Geomagnetic activity is expected to be Unsettled at first, possibly rising to give spells of Active to G1/Minor Storm early on Day 1 with the first forecast CME arrival. The second CME arrival is likely to give G1-G2 Minor to Moderate storms early Day 2, with a slight chance of isolated G3/Strong storm intervals. A return to mainly Quiet to Unsettled conditions is likely during Day 3 (18 Dec), perhaps increasing again to Unsettled to Active with any fast wind enhancement.

Energetic Particles / Solar Radiation: The count rate of energetic particles (high energy protons) is now just above the S1/Minor Radiation Storm threshold, with a chance of reaching the S2/Moderate level should there be further significant flares from the region near the west limb. The risk of Radiation Storms gradually reduces later in the period as the responsible region rotates off the disc

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Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	60	20	5
Strong	G3	No	15	20	2	1
Severe	G4	No	2	5	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	60	60	50	40
Very Active	R3 to R5 X	No	25	25	10	5

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	Yes	100	70	50	20
Very Active	≥ S3 *	No	5	5	2	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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